

Characteristics of asthenosphere distribution in the eastern segment of the Central Asian Orogenic Belt revealed by long period magnetotelluric (LMT) detection

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The eastern part of the Central Asian Orogenic Belt has experienced multiple histories of the Paleo-Asian Ocean, Mongolia-Okhotsk Ocean, and Paleo-Pacific Ocean tectonics. The multistage tectonic activities not only transformed the topographic features and lithosphere structure but also changed the characteristics of asthenosphere distribution. In order to reveal the characteristics of asthenosphere distribution in a complex background system, a 1,800 km long magnetotelluric (MT) profile was finished in the eastern part of the Central Asia Orogenic Belt, which started from Hohhot City in the south, passed through Xilin Gol City, Aershan City and Hailar City, and extended north to Mohe County, Heilongjiang Province. The profile consists of 33 long period MT stations. Two dimensional inversion was applied in this area employing the non-linear conjugate gradient method (NLCG) to obtain a two-dimensional electrical structural model. The results show that there are many low resistivity anomalies inside the lithosphere in the eastern part of the Central Asian Orogenic Belt whereas the surface mostly exposes Quaternary volcanic rocks or the ancient suture zone. These indicate that the low resistivity anomalies are related to asthenospheric uplifts. The asthenosphere shows high conductivity. The southern part is thin with a resistivity around $10\sim30\Omega\cdot\text{m}$, whereas the northern part is thick with a resistivity around $10\sim0.1\Omega\cdot\text{m}$. This electrical structural feature shows the heterogeneity in thickness and partial melting of both sides of the asthenosphere in the eastern Central Asian Orogenic Belt. The existing results from tomography show that the thickness of the asthenosphere in the Central Asian Orogenic Belt is thicker in the east but thinner in the west. Combined with regional geology, we propose that the thickness and partial melting of the asthenosphere as well as the lithosphere changed in the process of collisional orogeny. The asthenosphere in the eastern part of the Central Asia Orogenic Belt mainly experienced three stages including the Paleo-Asian Ocean tectonic system, the Mongolia-Okhotsk tectonic system, and the Pacific tectonic system. Therefore, we estimated that the north-south difference of asthenosphere in the eastern part of the Central Asian Orogenic Belt was probably caused by the time difference between the closure of the Paleo-Asian Ocean and the Okhotsk Ocean. The east-west difference was mainly affected by the Pacific tectonic system.